PROJECT facts

U.S. DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

High Efficiency Engines and Turbines

12/2002

OPTIMIZATION OF THE INJECTOR FUEL DISTRIBUTION FOR STABLE, LOW EMISSIONS COMBUSTION IN LEAN PREMIXED GAS TURBINE COMBUSTORS

PRIMARY PARTNER

Pennsylvania State University

TOTAL ESTIMATED COST

$ 259,392

CUSTOMER SERVICE

800-553-7681

STRATEGIC CENTER FOR NATURAL GAS WEBSITE

www.netl.doe.gov/scng

Description

Under the Advanced Gas Turbine Systems Research (AGTSR) program, Pennsylvania State University (PSU) is conducting experiments to gain insight for a methodology to prescribe fuel injection locations and timing to suppress combustion instabilities. Figure 1 illustrates the experimental combustor being used in the project. This combustor is constructed with multiple fuel injection locations. Tasks 1-5 of the project conduct experiments and data analyses for operation of a lean, premixed combustor over its entire operating range. Pressure, total heat release, and overall equivalence ratio fluctuations, as well as NO_X emissions are measured and analyzed. The role of the fuel feed system coupling with oscillations is evaluated and unstable operating regime characteristic groups are determined. Within each unstable operating regime, chemiluminescence imaging measurements are used to investigate the flame structure evolution for evidence of various instability mechanisms. Tasks 6-10 use the information of earlier tasks to determine the spatial and temporal fuel distributions which best control pressure oscillations within each unstable operating regime, to formulate a methodology for prescribing the optimum fuel distribution based solely on measurable properties of the instability, and to develop a strategy for determining fuel injection location and timing for verification in future single fuel nozzle tests.

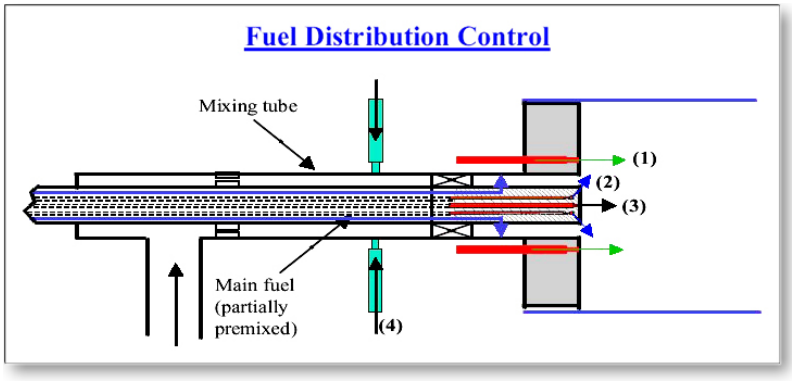

Figure 1. Fuel injection locations to control instabilities

Optimization of the Injector Fuel Distribution for Stable, Low Emissions Combustion in Lean Premixed Gas Turbine Combustors

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Duration

24 months

Goals

Combustion instabilities in low emission, lean premixed combustors have caused excessive noise, structural damage, and resulting removal of commercial turbines from service. Experiments and analyses in this project explore the effects of location and timing of fuel injection to control stability and emissions for lean premixed combustors.

Benefits

The advancement in this project of a methodology for defining the optimal fuel distribution for stable, low emissions operation of lean premixed combustors will aid engineers in the design of turbine combustors for improved stability and NO_X emissions performance.